Exclusive Pion Electroproduction at 12 GeV.

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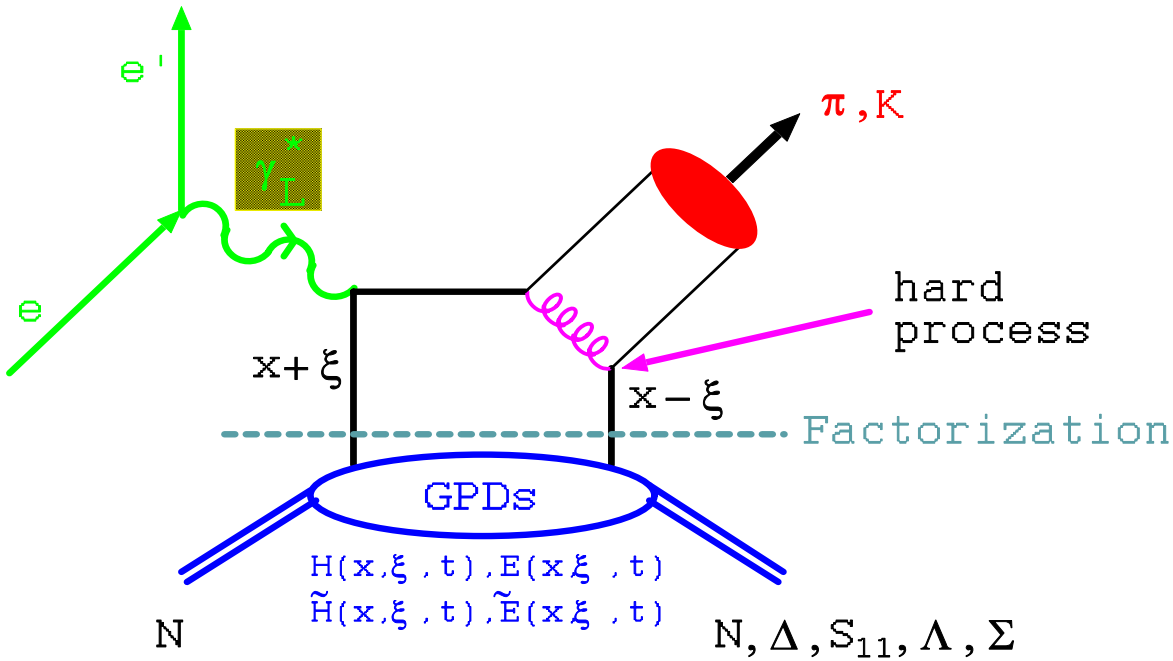
Generalized Parton Distributions

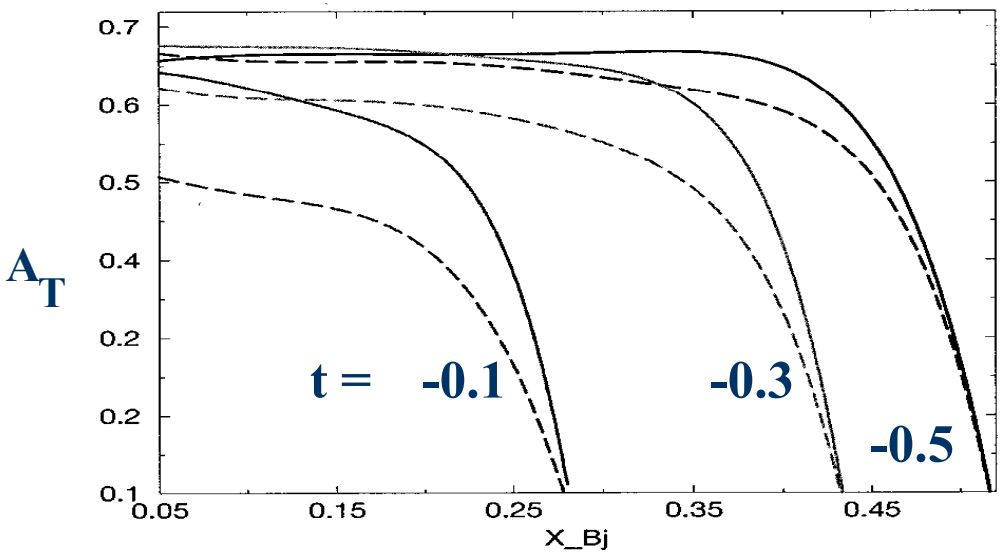


GPDs promise to provide a rigorous map of the entire set of fundamental quantities of hadronic structure such as form factors, polarized and unpolarized parton distributions and the spin content of the nucleon due to orbital excitations.

Generalized Parton Distributions

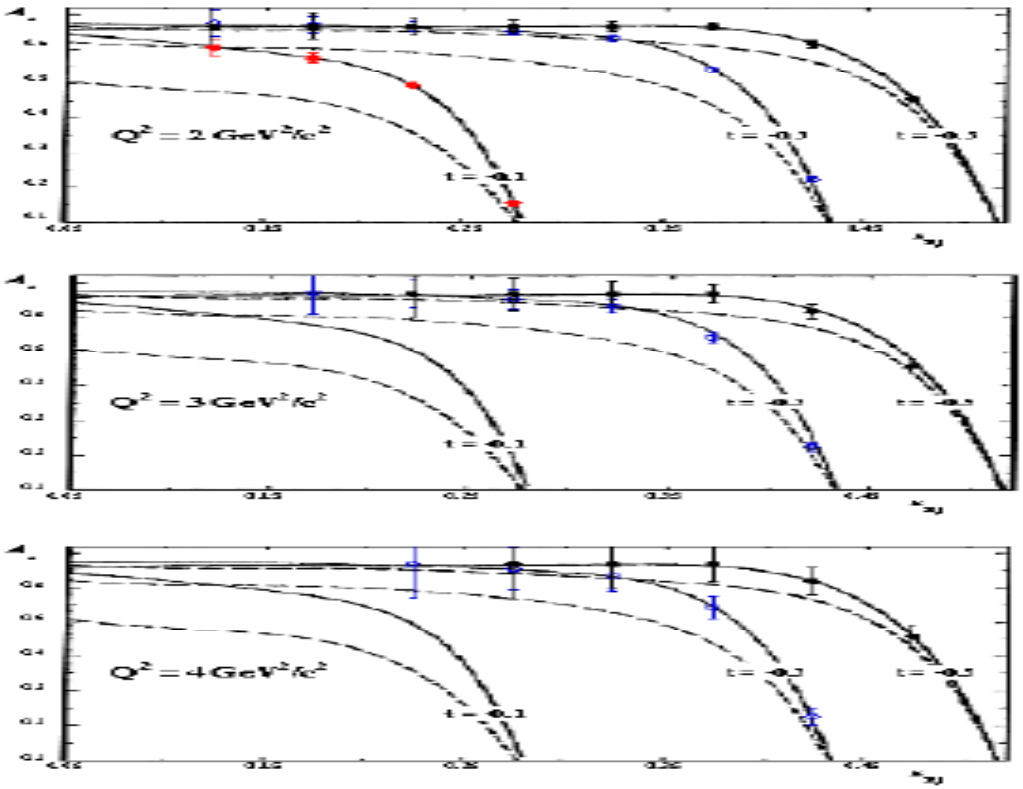
The polarized GPDs can be separated from the unpolarized ones by measuring pseudo-scalar meson production.

The single target spin asymmetries in pion electroproduction is one such observable which can be used to extract GPDs .



L. L. Frankfurt *et al.,* PRD **60,** 014010 (1999)

Single Target Spin Asymmetries at Hall B



A_T

x

$e + \vec{p} \rightarrow e' + \pi + n$

What Can Hall C Do?

$^3\vec{He} \equiv \vec{n}$ 11 GeV beam $e\,\vec{n} \rightarrow e'\,\pi^-\,p$

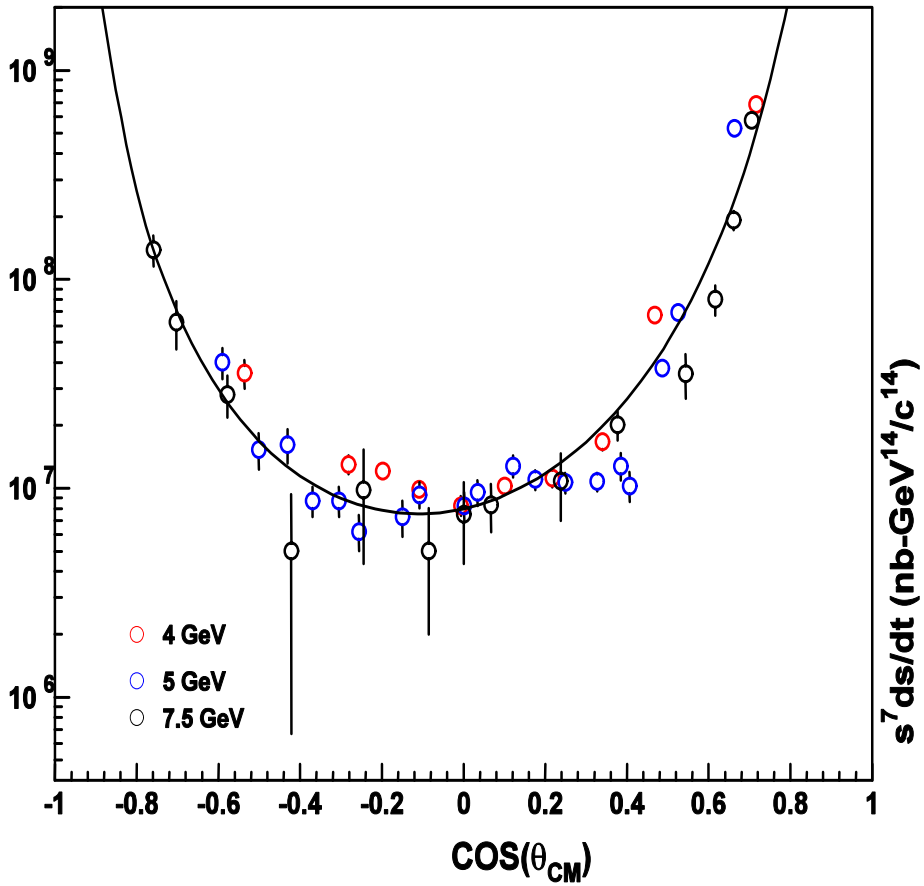
Need a transversely polarized ^{3}He target

10 μA beam on a target of thickness 10^{22} / cm^2

⇨ luminosity of 6.0×10^{35} / cm^2

e in the HMS and π^- in the SHMS

Rate Estimates

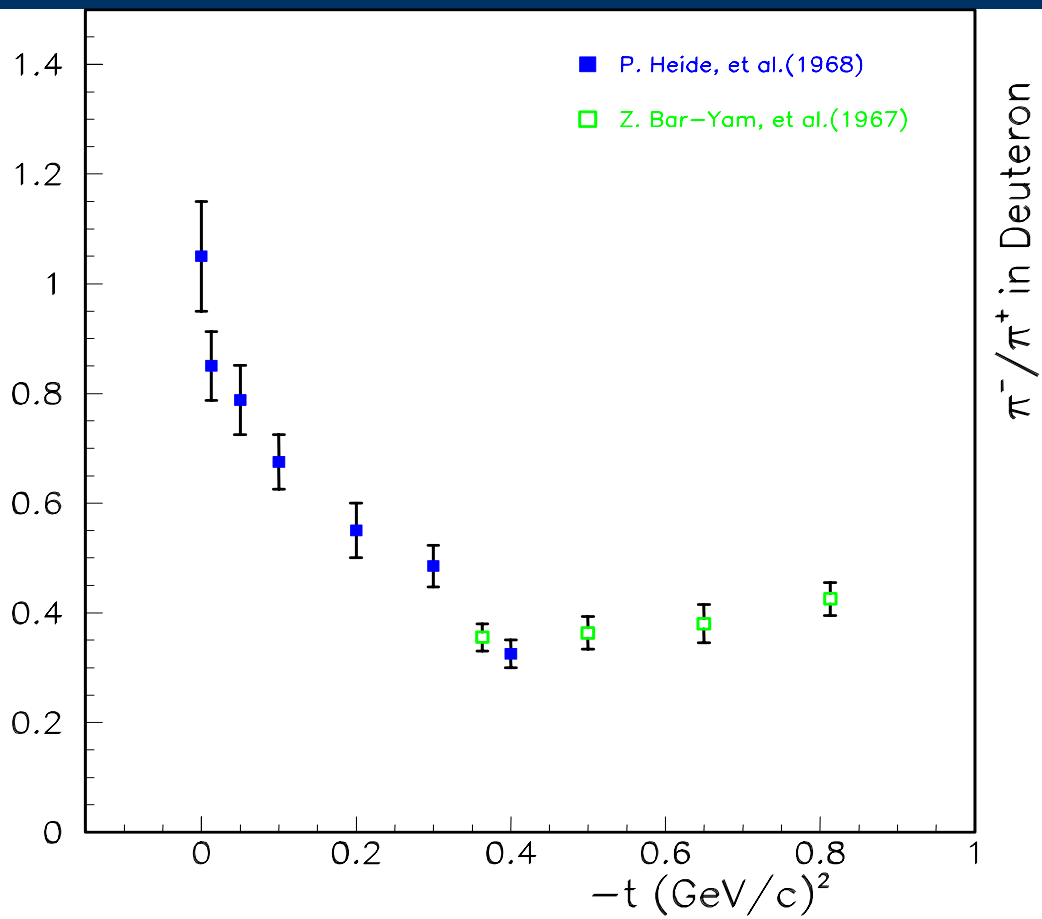


$\gamma p \rightarrow \pi^+ n$

Fit to $1/(1-z)^5/(1+z)^4$

R. L Anderson *et al.*, PRD **14,** 679 (1976)

Rate Estimates



Rate Estimates

$$\frac{d\sigma}{dt} = \frac{\pi}{p_\gamma p_p} \frac{d\sigma}{d\Omega_{CM}}$$

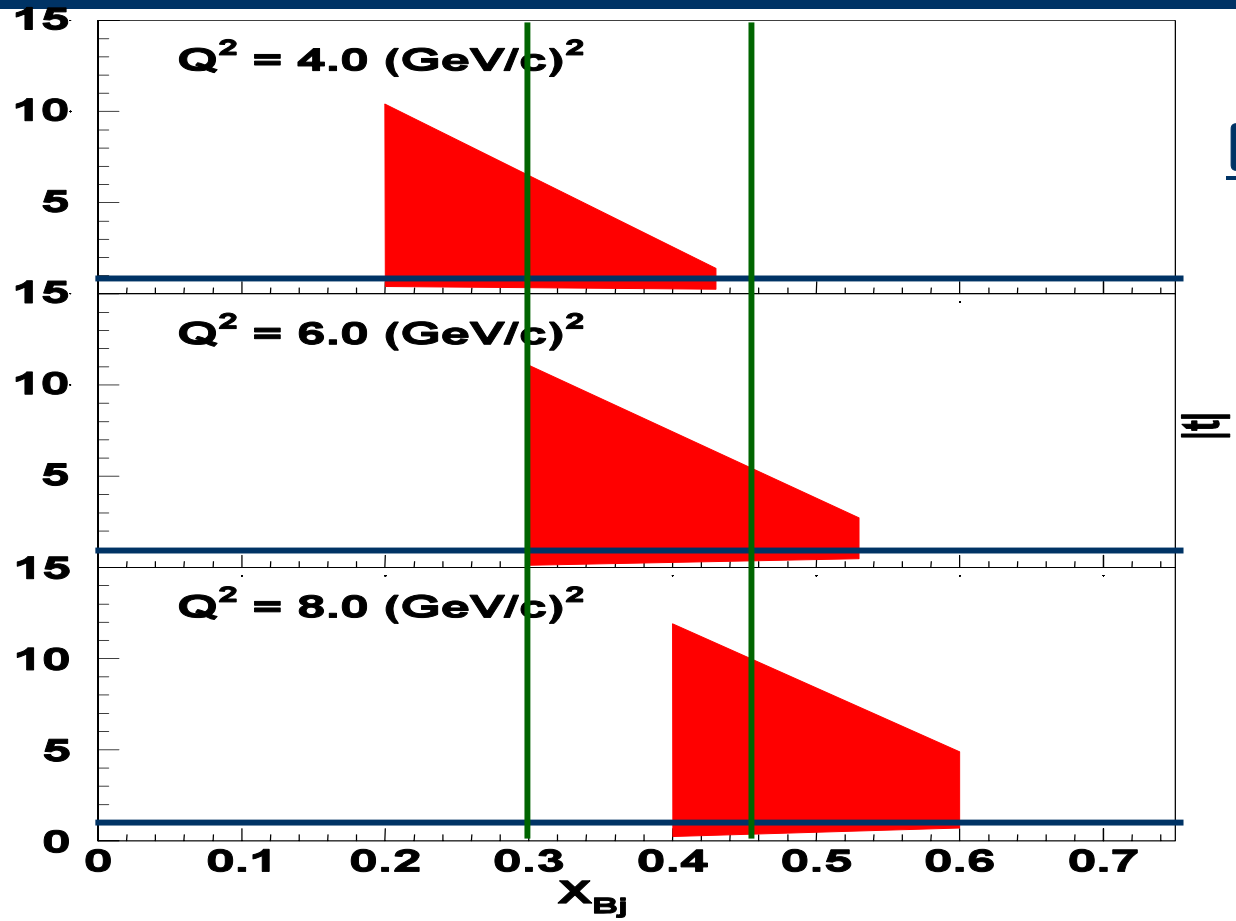
$$\frac{d^5\sigma}{d\Omega_e dE'_e d\Omega_\pi} = \Gamma \left(\frac{d\sigma}{d\Omega_{CM}} \right)$$

$$\Gamma = \frac{\alpha}{2\pi^2} \frac{E'_e}{E_e} \frac{1}{Q^2} \frac{1}{1-\varepsilon} K_{eq}$$

$$K_{eq} = \frac{W^2 - M^2}{2M}$$

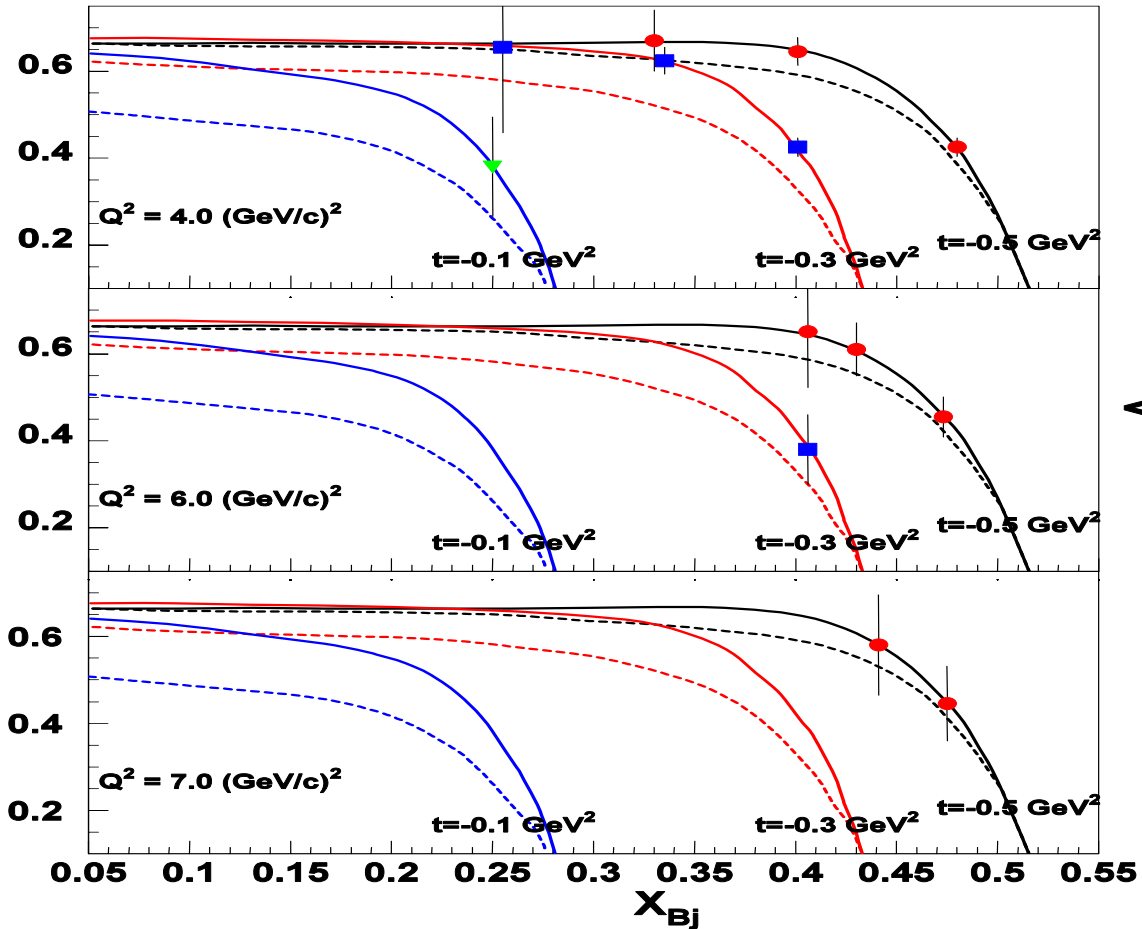
$$\varepsilon = \frac{1}{1 + 2\frac{|q|^2}{Q^2} \tan^2(\theta_e/2)}$$

X vs t at Fixed Q^2



For W > 2.5 GeV

Single Target Spin Asymmetries



$e \vec{n} \rightarrow e' \pi^- p$

$^3\vec{He} \equiv \vec{n}$

Kinematic Constraints

$E_e =$ 11 GeV W > 2.5 GeV

$E_e^{'} =$ 2.6 - 6.5 GeV $\theta_e = 13.5 - 28.0$

$P_\pi =$ 5.0 - 8.4 GeV $\theta_\pi = 7.4 - 19.0$

Target Polarization = 45 %, length = 40 cm

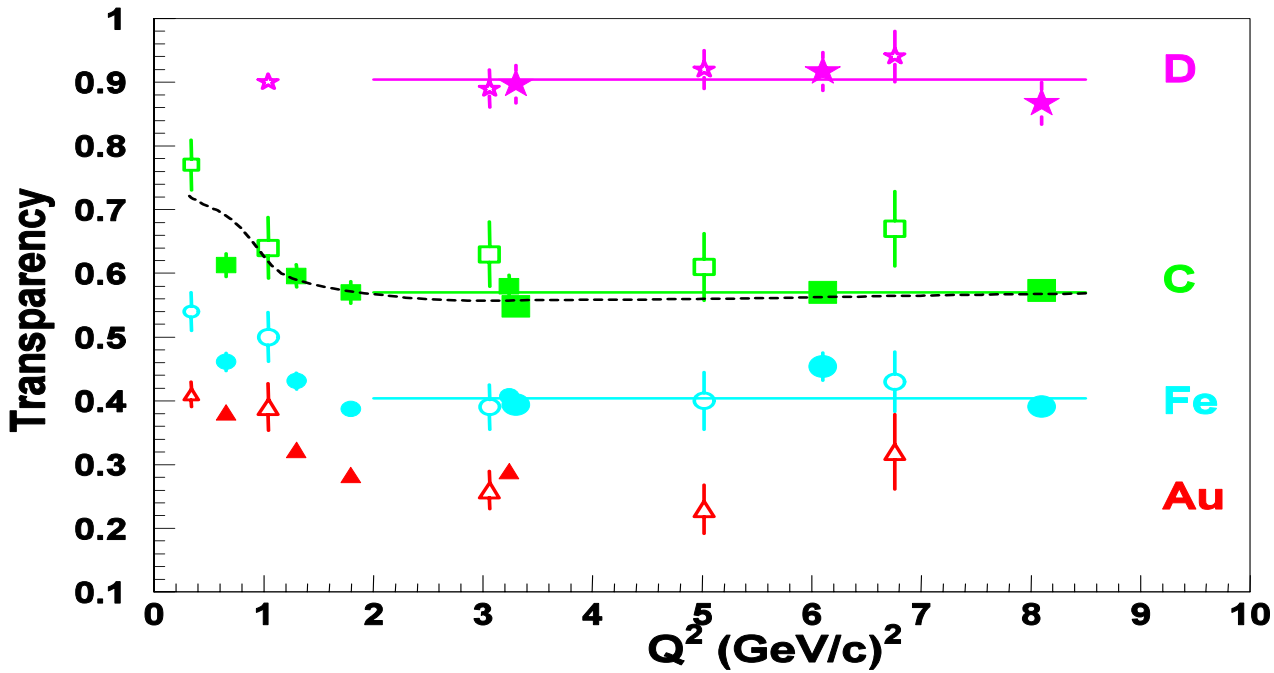
Color Transparency

CT refers to the vanishing of the h-N interaction for h produced in exclusive processes at high Q

- **At high Q , the hadron involved fluctuates to a small transverse size – called the PLC (quantum mechanics).**
- **The PLC experiences reduced interaction with the nucleus – it is color screened (nature of the strong force).**
- **The PLC remains small as it propagates out of the nucleus (relativity).**

A(e,e'p) Results

Q^2 dependence consistent with standard nuclear physics calculations



Constant value fit for $Q^2 > 2$ (GeV/c)^2 has $\chi^2/df \cong 1$

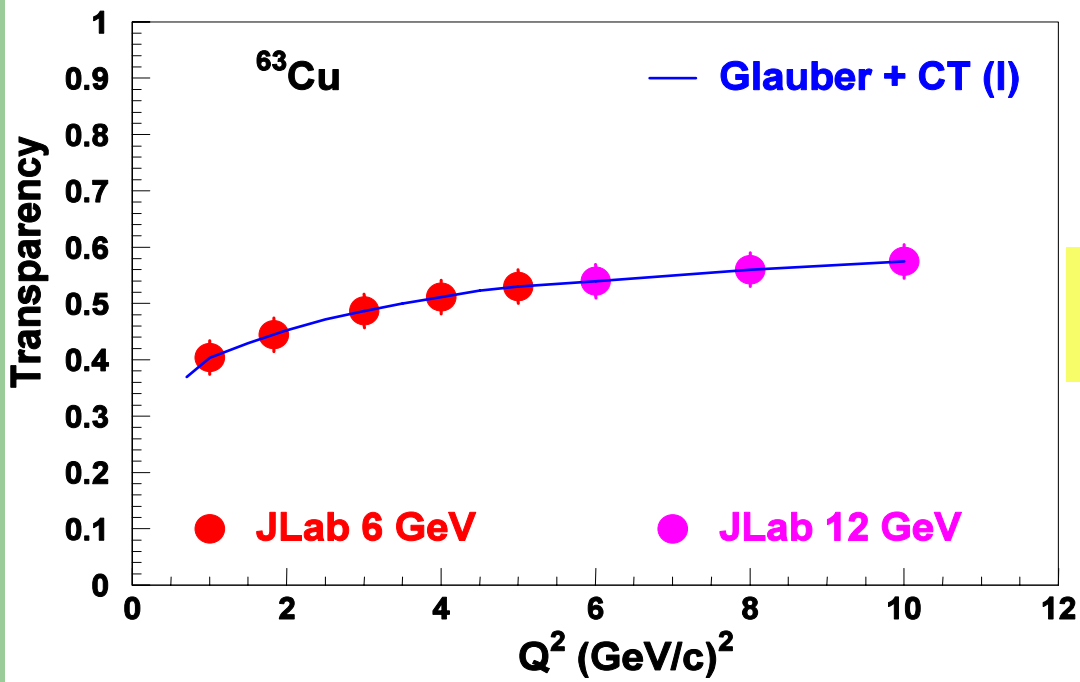
K. Garrow et al. submitted to PRC

qqq vs $q\bar{q}$ systems

- There is no unambiguous, model independent, evidence for CT in qqq systems.
- Small size is more probable in 2 quark system such as pions than in protons.
- Onset of CT expected at lower Q^2 in $q\bar{q}$ system.
- Formation length is ~ 10 fm at moderate Q^2 in $q\bar{q}$ system.

A Pion Transparency Experiment

JLab Experiment E01-107: A(e,e' π) on H, D, C, Cu, Au



Measurable effect predicted for $Q^2 < 5$ (GeV/c)^2

Projected combined statistical & systematic uncertainty of 5 – 10 % and the combined A & Q^2 effect measurable.

Detector Requirements

e / π separation :

HMS : 2.6 - 6.5 GeV
SHMS : 5.0 - 8.4 GeV

Summary

- With a polarized ^{3}He target one can measure the single target spin asymmetry using the process $e\ \vec{n} \rightarrow e'\ \pi\ p$

- With the HMS and SHMS a modest range in x and t can be covered at high Q^2

- But without a significant improvement in target thickness and polarization, precision measurements are difficult.